

Turin, Marquette Co., *B. Barlow*, August 10, 1901. WISCONSIN: Milwaukee, *Lapham*. ILLINOIS: rock barrens, Wakanda, *Gleason*, June 12, 1903; moist soil, Skokie Marsh, W. of Glencoe, *Sherff*, September 3, 1911. IOWA: Ames, *Pammel, Bell & Combs*, no. 197. OKLAHOMA: moist creek-bank near Shawneetown, McCurtain Co., *Houghton*, no. 3881 (distributed as *P. hydropiperoides*); by R. R. track near Howe, Leflore Co., *Stevens*, no. 27,981. The following is referred here as a somewhat exaggerated type, unique in the collections at hand, not resembling material from Oregon and Washington, which is referable to typical *P. Hydropiper*. CALIFORNIA: moist places in fields in the blue oak belt, 5 mi. so. of Redding, plentiful, *Heller*, no. 12,445 (distributed as *Persicaria punctata*).

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EFFECTS OF THE POST-PLEISTOCENE MARINE SUBMERGENCE IN EASTERN NORTH AMERICA.

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(Continued from p. 72.)

THE POST-PLEISTOCENE SEA IN RELATION TO THE INTERIOR DISTRIBUTION OF MARITIME PLANTS IN EUROPE.

Oceanic submergences in Europe corresponding to the Champlain submergence have been carefully studied, and with these submergences has been correlated the distribution of living plants and plant remains found in the post-glacial and inter-glacial deposits. Most of this work has been done in Scandinavia,¹ by the coöperation of geologists and botanists.

Miss Warburg² describes plants of the seashore which survive in the interior of Sweden, probably due to the fact that the sea formerly reached these places. The Mälaren [a lake near Stockholm] was once a bay of the Baltic Sea, and upon its shores still survive plants of the sea coast, such as *Triglochin maritima* and *Juncus Gerardi*. From her I quote as follows: "Besides the plants already mentioned Sernander gives still another example of this kind of relic in the flora

¹ For a survey of Pleistocene and Post-Pleistocene changes of level in Scandinavia, and a brief review of successive plant immigrations see W. F. Wright: *The Quaternary Ice Age*. 1914.

² Warburg, Elsa. On Relics in the Swedish Flora. *Geol. Soc. Upsala Bull.* 8: 146-170. 1908.

of Upland. In the middle of a flat meadow, a salt spring is situated, the salinity of which is derived from the marine clay of the surroundings. Because of drainage conditions the original seawater salts of the clay have not been quite removed, thus several elements of the old salt-loving vegetation have been able to remain around the spring. We find there not only the Malar relics, *Juncus Gerardi* and *Triglochin maritima*, but also *Glaux maritima* and *Alopecurus ventricosus*.

"*Elymus arenarius* is quoted as another example. It belongs generally to the flora of the seacoast, but is also found at the shores of the [lake] Vettern and Vänern and at some rivers in Norrland. However these occurrences might be due to quite accidental spreading, as this grass also lives in the interior in a place which never in post-glacial time has been reached by the sea."

Frödin¹ (p. 36), in a survey of the coastal vegetation of western Sweden, concludes that salt from the Post-Pleistocene marine submergence would not remain in the soil in sufficient quantities to influence the present vegetation.

However, a recent survey² of the coast vegetation of Sweden has the following statement: "Most of the species . . . found on shore-meadows, sea drift deposits, or in salt water, are in the interior confined to oecologically similar habitats within the districts of our region richest in nutriment. The localities are to a great extent situated below the highest marine boundary, and it is conceivable that at least some of the species—especially those having a resistant wiry subterranean system and usually uniting into hard associations—might be relicts from former seashores." "*Cynanchum vincetoxicum* and *Poa bulbosa* may probably be interpreted as surviving in the interior from old, higher seashore."

These citations tend to show that in Europe as in North America, the influence of Post-Pleistocene submergence upon the present distribution of the vegetation is somewhat problematical. The extent of submergence from the point of view of fossil plant remains is more significant.³

¹ Frödin, John. Tvenne västskandinaviska klimatfaktorer och deras växtgeographiska betydelse. Archiv för Botanik. Band 11, No. 12: 1-74. 1912.

² F. Hård av Segerstad: The main Features of the floral plant-geography of southern Sweden. Bot. Notiser 1925: 222-250. 1925.

³ For a critical correlation of plant remains with the former extent of the post-glacial sea in eastern Sweden, see U. Sundelin: Ueber die spätquartäre Geschichte der Küstengegenden Oestergötlands und Smålands. Geol. Soc. Upsala Bull. 16: 195-242. 1918-1919.

INVESTIGATION OF THE ST. LAWRENCE VALLEY AND THE NEW
BRUNSWICK SALT SPRINGS.

During the summer of 1923, Mr. N. C. Fassett and the writer investigated a region included in the Champlain submergence area, from Burlington, Vermont, to Montreal, and through the St. Lawrence Valley to Matane County, Quebec, thence into New Brunswick by the Matapedia River, along the coast to Moncton, and through the Kennebecasis Valley to St. John and the coast of Maine (Mr. Fassett was engaged in research on estuarine plants, and the writer is indebted to him for the identification of many plants collected during this trip). It was felt that investigation of a region known to have been submerged in the Champlain period—such as the Lower St. Lawrence, or the Kennebecasis Valley of New Brunswick—might disclose features of plant distribution not to be seen farther to the southward. However few, if any, direct evidences were seen of the adaptation or survival of maritime plants inland, under circumstances that would allow one to conclude that they existed merely because of the salt which had remained in marine clays deposited during the Champlain submergence.

Along the south side of the lower St. Lawrence the elevated clay terraces are very prominent, Chalmers¹ recording a subsidence of from 345 to 375 feet in the region below Rivière du Loup, but with the exception of *Euphrasia* and *Juncus balticus* var. *littoralis* noted on the clay banks just west of Trois Pistoles and elsewhere, no maritime plants were seen on these terraces. *Juncus balticus* var. *littoralis* also occurs in fresh meadows in proximity to the ocean and along the tidal shores of the St. Lawrence, extending inland to the Great Lakes.

It is of interest to record the progression of maritime plants along the St. Lawrence River. No attempt was made to trace the exact extension of these plants westward, but at St. Augustine, Portneuf County, appeared *Triglochin maritima*; at St. Michel, Bellechasse County, *Ranunculus Cymbalaria*; at St. Jean-Port-Joli, L'Islet County, *Solidago sempervirens*, *Limonium trichogonum*, *Plantago decipiens*, *Spartina alterniflora*, *Salicornia europaea*, *Rumex pallidus*, *Lathyrus maritimus* and *Atriplex patula* var. *hastata*; at St. Roche des Aulnaies, L'Islet County, *Iris setosa* var. *canadensis*, *Cakile edentula*, *Mertensia maritima*, *Allium Schoenoprasum* var. *sibiricum*, and *Senecio Pseudo-*

¹ Ann. Rept. Can. Geol. Survey. 1886. 8M.

Arnica; and about three miles west of Rivère du Loup, Temiscouata County, *Potentilla pacifica*, *Scirpus nanus*, and *Ammophila breviligulata*. The halophytic vegetation of Temiscouata County is described in detail by Marie-Victorin (l. c.).

The subsidence in the region of the Bay of Chaleurs has been described by Chalmers,¹ but the marine deposits are not so striking as those along the St. Lawrence River. The less severe climate, as the name of the bay would suggest, offers opportunity for the existence of southerly types of both plants and animals, probably due to the great expanse of warm, shallow water, protected from ocean currents. Even oysters flourish here. These southern animals—and very likely the southern plants, such as *Aster subulatus* var. *obtusifolius*—came at a time subsequent to the Champlain submergence (See previous quotation from Upham). The Champlain Sea covered relatively small areas near the coast, and extended up the river valleys. To quote from Chalmers,² “There was first a subsidence, which seems to have commenced in the glacial period, continuing until its close or later, the land . . . sinking about 220 feet below its present level relative to the present high tides of the Bay of Fundy. When this subsidence had reached its maximum the coast districts were partially submerged and the isthmus of Chiegnecto almost wholly. One arm of the bay would form a strait along the Petitcodiac and Kennebecasis valleys, making the longitudinal tract lying to the southeast an island.” Accompanying maps show the presence of marine clays and sands throughout the Kennebecasis Valley. Hence, if any single region in New Brunswick should show evidences of the survival of marine plants upon the Post-Pleistocene marine deposits, it seems that the Kennebecasis Valley should be the region, but only *Spartina Michauxiana* which grew commonly on sandy roadsides, often at a fairly high elevation above the Kennebecasis River, was observed. It is possible that here the plant may owe its existence to the marine deposits.

In the Kennebecasis Valley are salt springs which in earlier days were extensively worked. From the largest of these, about four miles northeast of Sussex, salt water flowed from a driven pipe at a considerable pressure, and in the surrounding miniature salt marsh, *Salicornia europaea* grew abundantly. Intermingled with it were

¹ Ann. Rept. Can. Geol. Survey, 1887–1888: 20N.

² Ann. Rept. Can. Geol. Survey, 1888–1889. 10N.

Atriplex patula var. *hastata*, *Juncus bufonius* var. *halophilus*, *Spergularia salina*, and a single plant of *Ranunculus Cymbalaria*. Within the influence of the salt, within about twenty meters from the pipe, grew *Agrostis alba* var. *maritima*, *Distichlis spicata*, *Puccinellia paupercula* var. *alaskana*, *Scirpus acutus*, *Scirpus americanus* and *Juncus balticus* var. *littoralis*. It is possible that surface springs may have contributed some salt water to these plants. This was the only locality in which *Juncus balticus* var. *littoralis* was found at a situation remote from the ocean, nor did search reveal it at any other place in the valley.

The other salt springs are less accessible, since they are away from the main avenue of travel. Two of these are found along Salt Spring Creek, about thirty miles southeast of Sussex. At the first of these to be visited, at Salina, salt water trickled from a small depression about five meters from the stream, and communicated to the stream by means of a very small brook, which was nearly dry. About this were growing a few plants of *Atriplex patula* var. *littoralis* and *Agrostis alba* var. *maritima*. No other halophytes were seen. At Salt Springs, a mile to the northward along the same stream, preliminary attempts had been made to produce salt upon a commercial scale. A well was driven and from an iron pipe of about 10 cm. diameter the salt water gushed forth. Although fully as much salt water flowed as in the spring at Sussex, maritime plants with the exception of *Agrostis alba* var. *maritima* were entirely lacking. The ground about the pipe is discolored by iron, and the water soon makes its way to a small brook which cuts through the meadow turf. The lack of halophytes may be due to several causes; namely, the site of the well (which was driven in 1895) may not have been marked by surface springs sufficient to maintain such plants, or drainage might be such that salt-marsh plants would not prosper, or, what seems more reasonable, the recent opening may not have allowed salt marsh plants to arrive there from other parts.

Of these New Brunswick springs Bailey¹ writes, "The rocks of the Lower Carboniferous formation are in several places the scoures of salt springs, as in the vicinity of Sussex in Kings County, at Salt-Spring Brook, parish of Upham, in the same county, and on the Tobique River, in Victoria County. Of these the Sussex springs are the most important. There are half a dozen springs within a radius

¹Bailey, L. W. Ann. Rept. Can. Geol. Survey. 1897. 121 M, 122 M.

of a quarter of a mile, all about six miles from Sussex station, but less than a mile from the line of the Intercolonial Railway. No attempt has been made to manufacture salt in other localities in the province. Brine springs also occur at Salina. . . . This locality was visited by Mr. R. Chalmers, of the Geological Survey, in 1895, when a boring in the highly inclined Lower Carboniferous rocks had been made to a depth of 330 feet. A specimen of the brine was collected . . . remarkable because of the large proportion of potassium."

Since the springs have been used by man "for nearly a century" it is impossible to decide whether the maritime plants occur naturally there, i. e., as a result of the post-glacial submergence, or whether they have been unconsciously introduced by man in the extraction of salt, or from time immemorial by animals frequenting the salt springs, or by winds or birds. The salt water of the Petitcodiac lies less than forty miles to the northward. It is from that direction that one might naturally expect the transfer of maritime plants.

It is of interest to compare the vegetation of these springs with the vegetation of the salt springs of western New York. A list of such halophytes follows:

HALOPHYTES IN WESTERN NEW YORK.

<i>Ruppia maritima</i> L.	<i>Juncus Gerardi</i> Loisel.
<i>Najas marina</i> L.	<i>Ranunculus Cymbalaria</i> Pursh.
<i>Spartina alterniflora</i> var. <i>pilosa</i>	<i>Chenopodium rubrum</i> L.
(Merrill) Fernald	<i>Atriplex patula</i> L.
<i>Agrostis alba</i> var. <i>maritima</i>	<i>Salicornia europaea</i> L.
(Lam.) Mey.	<i>Spergularia salina</i> J. & C. Presl.
<i>Diplachne maritima</i> Bicknell	<i>Spergularia marginata</i> (DC.)
<i>Puccinellia distans</i> (L.) Parl.	Kit. (See RHODORA 12: 157.
<i>Puccinellia fasciculata</i> (Torr.)	1910.)
Bicknell	<i>Spergularia alata</i> Wiegand (See
<i>Eleocharis rostellata</i> Torr.	RHODORA 22: 15. 1920.)
<i>Scirpus nanus</i> Spreng.	<i>Ranunculus Cymbalaria</i> Pursh.
<i>Scirpus campestris</i> var. <i>paludosus</i>	<i>Aster subulatus</i> Michx.
Fernald.	<i>Aster angustus</i> (Lindl.) T. & G.
<i>Juncus bufonius</i> var. <i>halophilus</i>	<i>Pluchea camphorata</i> (L.) DC.
Buchenau & Fernald.	

HALOPHYTES IN THE NEW BRUNSWICK SALT SPRINGS.

<i>Agrostis alba</i> var. <i>maritima</i> (Lam.) Mey.	<i>Juncus bufonius</i> var. <i>halophilus</i> Buchenau & Fernald.
<i>Distichlis spicata</i> Greene	<i>Atriplex patula</i> L.
<i>Puccinellia paupercula</i> var. <i>alaska-</i> <i>kana</i> Fernald & Weatherby	<i>Salicornia europaea</i> L.
	<i>Ranunculus Cymbalaria</i> Pursh.
	<i>Spergularia salina</i> J. & C. Presl.

The New Brunswick salt springs support *Distichlis spicata* and *Puccinellia paupercula* var. *alaskana*, neither of which is reported from western New York. A striking contrast appears in the Champlain region in regard to the presence of halophytes, for with the exception of *Atriplex patula*, not uncommon inland as a weed, no true halophytes are found about Lake Champlain. All three regions were probably equally submerged by the Champlain Sea, but in New York and New Brunswick, the halophytes occur in the neighborhood of saline deposits. One therefore comes directly to the conclusion that salt deposited by the Post-Pleistocene marine invasion alone does not support the growth of true halophytes in eastern North America.

(To be continued.)

SOME VARIETIES OF ARTEMISIA BOREALIS.

M. L. FERNALD.

ARTEMISIA BOREALIS Pall., var. **latisecta**, n. var., a var. typica recedit foliis rosulatis crassioribus, segmentis oblongis vel oblanceolatis saepe 3-4 mm. latis.—Newfoundland, Labrador and eastern Quebec. NEWFOUNDLAND: talus of trap sea-cliffs, French (or Tweed) Island, Bay of Islands, September 2, 1926, *Fernald, Long & Fogg*, no. 476 (TYPE in Gray Herb.). LABRADOR: Rama, August 20-24, 1897, *Sornborger*, no. 62, in part. QUEBEC: Southwest Point, Anticosti Island, August, 1861, *Hyatt, Shaler & Verrill*.

In typical *Artemisia borealis* and in var. *Purshii* Besser the rosette-leaves are much more finely divided, the linear to narrowly oblanceolate divisions being mostly 0.5-1.5 (rarely 2) mm. wide. Var. *latisecta* has the nearly glabrous involucre of typical *A. borealis* rather than the densely villous involucre of var. *Purshii* Bess. in Hook. Fl. Bor.-Am. i. 326 (1834).